THE MARBLES OF VERMONT.

AN ADDRESS

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BEFORE THE

VERMONT HISTORICAL SOCIETY,

IN THE PRESENCE OF

THE GENERAL ASSEMBLY OF VERMONT;

BY

ALBERT D. HAGER.

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THE MARBLES OF VERMONT.

Mr. President:—

When I call to mind the fact, that the Vermont Historical Society has heretofore, had for its Speakers, some of the greatest, the best, and the most talented sons of Vermont, and when I reflect upon my own inexperience as a public speaker, and appear before you, while yet the eloquent oration * of last evening is fresh in your minds, as well as the highly interesting address just delivered, † I can, under these circumstances, but feel embarrassed, and there arises within me a lurking fear that I shall fail to discharge the duties incumbent on me in a manner creditable to myself, or satisfactory and acceptable to this intelligent audience. But inasmuch as you have manifested your confidence in my ability, by inviting me to address you, and appearing before me this evening, I shall enter upon the performance of my task, craving your indulgence while I present a few matter-of-fact statements in relation to the marbles of Vermont, and call your attention to the beautiful specimens which the proprietors of quarries have kindly furnished me, for the State Cabinet.

The Marbles of Vermont may be divided into six distinct classes; viz: the Verd Antique, or Roxbury Marble; the Dove Colored, or Swanton; the Isle La Mott; the Variegated, of Plymouth; the Winooski and Mosaic of Colchester, and the Vermont Marble. Each of these, and especially the latter, present almost an infinite variety, varying in color, structure and composition, but retaining the peculiar characteristics of its class.

* Hon. Edward Everett's Oration on the Life and Character of Washington.

† By Rev. P. H. White.

I shall speak of each class separately, and lest I may tire the patience of the audience, shall be very brief in my remarks.

The "Verd Antique Marble,*" so called, will first claim our attention. Properly speaking this is a Serpentine or an Ophiolite, and not a marble ; for all marbles are limestone, but all limestones are not marble, the difference consisting in this: those limestones that occur in extensive beds, from which large blocks can be obtained,—free from stratification seams — open or close joints or "cuts,"—and also free from impurities, in the form of slate, quartz, or spar, and susceptible of receiving a polish, are called marbles; but where they are cut up with numerous joints, or seams, or have a broken or slaty structure, so as to be obtained only in fragmentary masses, they are called limestones.

The Serpentine of Roxbury and Cavendish, shows, by an analysis, as determined by Dr. A. A. Hayes, of Boston, that no lime enters into its composition but it is composed of Silica (43.34,) Magnesia (39.55), Protoxyde of Iron (5.32) and Water (11.79), and combined in such proportions as to render it one of the most indestructible rocks in nature. The Verd Antique of the ancients, and that of Europe, which in Germany and Spain is now wrought into table tops, mantles, pillars, pilasters, &c., has in its composition ten per cent. or more, of carbonate of Lime, which renders it softer and more easily worked, but when placed in exposed situations it is less durable then the Serpentine of Vermont. It is quite abundant in the State, and outcrops of it are generally found in the Eastern limits of the talcose slate, extending from Massachusetts to Canada ; and it often forms the dividing line between the talcose and mica slate formations.

It is near this line that the gold of Vermont is found. Wherever the talcose slate is found east of the Serpentine (or Soapstone, which is generally associated with it,) gold is usually found, but seldom if ever in workable quantity, except there be a deep eroded valley in the immediate vicinity, with an open slate rock at the bottom, for a "bed rock," in the cavities of which the gold is found.

Two quarries of Serpentine have been opened and worked in the State—one at Cavendish and one at Roxbury ; but in consequence of the great expense of quarrying and working it,—the difficulty in sell-

* Cubic blocks of Serpentine from the quarry at Roxbury, and a slab from the Cavendish quarry, were exhibited.

ing it for remunerative prices,—want of sufficient capital,—bad management, or from some other cause, both quarries are now abandoned.

It is to be hoped, however, that a greater demand for the article will soon be created, and such advances made in the arts as to enable men to work the Serpentine with the same ease and facility that common white marble is now worked, when both quarries, and perhaps others in the State, will again be opened and successfully wrought.

Many beautiful specimens have been sent abroad, from the works at Roxbury and Proctorsville, among which may be noticed the block, forming the base of the Franklin Statue, in Boston, Mass. This block was sent from Roxbury, and will be looked upon and admired by thousands, and if suffered to remain unmolested by the hand of man, will effectually resist the corroding influence of atmospheric agencies, and will remain as long as the American people delight to honor the name of Franklin.

The Dove colored Marble of Swanton is a very compact and fine grained limestone, being composed of nearly 95 per cent. of carbonate of Lime.*

It has only been quarried at Swanton, for a marble, but in several places it is used for burning into quicklime, as at Colchester, Winooski Falls, &c., and for a quicklime it is equal to any thing in the State.

I will remark, in this connection, that in order to secure good material for quicklime, nothing must be used but rock that is of a compact and close grained structure; for it is found that the coarse grained marbles, that often have 98 per cent. of carbonate of lime, make but a poor ashy colored quicklime, while a compact rock, that has not more than 60 per cent. of the carbonate of lime, will often make a good white quicklime; hence, as much seems to depend upon the structure as the composition of the material used.

The color and fineness of the Swanton Marble seem to fit it admirably for the purpose of floor tiling. When used alternately with the Isle La Motte, or Black marble, it makes one of the best floor pavements that can be produced. Some varieties of it, as that found at

* Analysis of Swanton Marble: Carbonate of Lime (94.66), Carbonate of Magnesia (0.23), Alumina and Iron (1.09), Insoluble matter—mostly Silica (2.39), Water and loss (1.63). *Olmstead.*

Whiting, are admirably suited to the purpose of being used as an ornamental marble, for table tops, &c., it being traversed by stripes and concretionary masses, of what seems to be a variety of red jasper. The great obstacle presented in working this variety of marble is the occurence of numerous "cuts," and close joints, which are generally very numerous, and often prove a serious drawbaek, where large sound blocks are desired.

The Isle La Motte marble * is found in the Champlain valley and was the first marble ever worked in the State. It derives its name from the Isle La Motte, in Lake Champlain, where several quarries are now successfully wrought, some of which were opened prior to the Revolutionary War.

It is nearly black, of a compact structure, and is susceptible of receiving a good polish. When sawed, it makes an excellent marble for floor tiling, and specimens of it may be seen in the public edifices, and costly mansions, of the principal cities of our Union.

The facility with which it can be quarried, and the ease with which it can be split and wrought into blocks, render it valuable for the purposes of a building stone, and in the construction of abutments and piers for bridges. At the Fiske quarry alone, on Isle La Motte, there are this year quarried about 240,000 cubic feet of this stone, which is mainly used in constructing piers for the "Victoria Bridge," at Montreal. †

This marble is found on many of the islands of Lake Champlain, and upon its banks in several places.

A quarry was opened in 1851, and worked for a time at Larabee's Point, by the Shoreham Marble Co., but it is now abandoned.—Button Harbor Island, West of Ferrisburgh, is mainly composed of the Isle La Motte marble, of excellent quality.

It has never been used at this place as a marble, but is extensively quarried by some of the proprietors of Iron Works, in Essex County, N. Y., for a flux, to be used in their iron furnaces.

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* Composition of La Motte marble: Carbonate of Lime (87.94). Carbonate of Magnesia (4.56). Alumina and Iron (2 60). Insoluble matter, mostly Silica (4.80). Water and loss (0.10)—and a trace of protoxide of Manganese. *Olmstead.*

† Last year 243,000 cubic feet were quarried and 4-5 hamered into blocks, —the two preceding years, they sent off 520,000 cubic feet, employing from 60 to 100 men.

Immediately on the top of the Isle La Motte marble at this place, there is a stratum, 22 inches thick, of what is called the "Black River Limestone," being principally composed of a fossil coral (the columnaria sulcata and columnaria alveolata,) which, if sawed and finished, would produce one of the finest fossil marbles extant. This fossil* is usually called a petrified hornets nest, or honey comb, from the strong resemblance that the pentagonal columns have to the cells of the comb of a bee or wasp. Large and sound blocks of this fossil marble could easily be procured at this island, and be transported by water to market.

The Brecciated or Variegated Marble, of Plymouth, † seems to be of a distinct class, and by analysis, as determined by T. Sterry Hunt, Esq., is found to be a dolomite, composed of carbonate of Lime (53.9), carbonate of Magnesia (44.7), Oxide of Iron and Alumina (1.3).

Unlike most dolomites, this marble resists the action of atmospheric agencies in a remarkable degree, and is durable when exposed to the weather.

It is susceptible of a high polish, and were it a foreign production, would doubtless be highly prized as an ornamental marble.

It occurs in the talcose slate formation, near the center of the town of Plymouth, at an elevation of about 250 feet above Plymouth Pond, and is well situated for drainage, and about six miles from the Railroad Station. This quarry was opened about 25 years ago, and was worked for a while; but as white marbles were in demand, to the exclusion of all others, at that time, the enterprise was abandoned, and the quarry has been used since, only for the purpose of obtaining material for the manufacture of quicklime. Having in its composition less than 54 per cent. of carbonate of lime, still being of a compact structure, it produces, when burned, a nice quicklime, known in the market as the "Plymouth White Lime."

Could some enterprising man now engage in the business of quarrying and working this marble, success would doubtless attend his efforts; for the marble is sound, the formation extensive, the

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* Specimens of the coral limestone were exhibited.

† Specimens were exhibited which had been presented to the State, by Isaac A. Brown, Esq., of Proctorsville.

quantity inexhaustible, and the facilities for quarrying are unsurpassed by any in the State.

The Winooski and Mosaic Marbles are evidently of the same formation, possessing the same general characteristics, but differing somewhat in their composition and structure.

The Mosaic, so called from its resemblance to artificial Mosaic work, is found near Burlington. Like the Winooski, it usually has a reddish color, and for many purposes it must be regarded as a very beautiful marble for ornamental work. Upon examination, it is found to be principally composed of fragments, varying in size from a barley corn to blocks a foot or more in diameter, which appear to have been promiscuously piled together, after which they were cemented with a substance having much more lime in its composition than the fragments themselves.

This cement, too, has a lighter color than the other portions of the mass, which gives it the beautiful sparry and variegated appearance which is observed in the Mosaic Marble.

It equals in beauty the artificial Mosaic work of Herculaneum and Pompeii, and it is equally interesting to the man of thought, when he looks upon that marble, and contemplates the changes that must have been wrought upon the crust of the earth, to thus reduce to fragments, and collect together again, such masses of the shivered rocks.

The angles of the fragments are seldom rounded, which proves that they were not transported far by water, but remained in a quiet state, in tranquil water charged with a calcareous substance, which, upon being deposited, filled the cavities, and converted the whole again into a solid mass.

The Winooski Marble* is more extensively distributed than the Mosaic, being found to extend from Canada line to Sudbury, but in no place is it so well developed as at Mallett's Head, in Colchester.

The strata at this point are nearly horizontal, and in many places form the bank of the lake. One of the best quarries is so situated that a vessel can be brought up alongside, and loaded

* The speaker here exhibited fifteen specimens of the Winooski Marble in cubic blocks, which had been presented to the State, to be placed in the State collection, by Hon. David Read, of Winooski Falls.

with blocks, with as much ease as they are usually loaded upon carts or cars at inland quarries. The marble occurs in beds, or strata, varying in thickness from one to six feet, and being a good marble to split across the bed, or *grain*, blocks of any required size can very readily be obtained.

The marble is susceptible of a high polish, and will resist, in a remarkable degree, the corroding influence of atmospheric agencies. Its composition, as determined by an analysis by C. H. Hitchcock, Chemist of our Geological Survey, is, carbonate of lime (35.31), carbonate of Magnesia (42.23), Silica (10.30), Alumina and Iron (12.25).

Like the serpentine, and the variegated, of Plymouth, this marble is hard to be worked, and consequently, when polished, is hard to deface by scratches or acids, and this fact of its hardness should attach to it additional value.

Its color seems to admirably fit it to the purpose of ornamental work, for pier and centre tables, and no marble can excel it in beauty or durability. The rich colors of the Rosewood or Mahogany frames, do not exceed, in beauty or variety, those to be found in a slab of the Winooski Marble. A few openings have been made in Colchester, but quarries have never been extensively wrought; but with the increased facilities that are likely to be presented for working hard marbles, the Winooski and Mosaic will not be neglected, but will doubtless be successfully worked, and yield a rich reward to those so fortunate as to own a quarry.

The most extensively developed, and thus far the most profitably worked, marble of Vermont, is that found in the so called Stockbridge Limestone formation, and which bears the name of Vermont Marble. Of this marble there is a great number of varieties. They are usually nearly pure carbonate of lime, and *white* is the prevailing color.

This formation is found on the West side of the Green Mountains, and extends nearly the entire length of the State. The most profitable quarries, yet worked, are found in the Counties of Rutland and Bennington.

It generally occurs in strata, varying in number from two to twenty-five, placed one above another, with seams between them, corresponding with the planes of stratification.

At these seams, called by quarrymen "floor beds," "bed seams," or "riving seams," the strata are readily parted, by inserting wedges, after channels are cut around the block to be removed. The channeling is done with drills, made for that purpose, and from two to ten square feet per day is a day's work for a quarryman, the amount varying with the hardness of the marble, and the skill of the workman. In some quarries, the riving seams are a stratum of very fissile slate, an inch or more in thickness, and often so much disintegrated that an open space occurs between the beds, in which case channeling is unnecessary, as large blocks can easily be split off by drilling holes and using riving wedges.

As a general thing, the riving seams are open at the surface, but upon penetrating the quarry, they grow closer, and often nearly disappear, and render the labor of removing large blocks more difficult and expensive; but the proprietors are amply remunerated, in finding the marble correspondingly more compact and of better quality, as the quarry is penetrated.

The strata of marble vary in thickness from eight inches to six or eight feet,—the thickest beds being usually found where the marble is coarse grained and friable. From observations made, it is quite apparent, that the marble beds thin out, as they approach the North from Dorset, where the thickest beds in the State are found. In tracing the beds to the North, it is also found, that the marble is finer grained and more compact, than at the points farther South on the same beds.

From the statistics obtained at twenty quarries, where there were employed 989 men in quarrying, it appears that there were quarried, last year, 3,063,240 feet of Vermont marble, which if sawed into slabs, would cover more than seventy acres with marble two inches thick.

There are in the State 27 mills, with 176 gangs of saws, where there are annually sawed 1,788,000 feet of marble, or enough to cover 41 acres with sawed marble.

At these mills there are employed 312 men, which, added to the number engaged in quarrying, shows that more than 1300 men were employed, last year, in this leading enterprise in our State. The sad reverses which have fallen with such heavy hand upon

the manufacturing and industrial interests of our country, have reached the marble dealers, in some cases, and compelled them to curtail the amount of help this year, as the demand for marble has not been as great as heretofore. But as business again revives, the marble quarries will again resound with the musical click of the quarryman's drill, and the proprietors will again reap the rich reward which they so justly deserve for their energy and perseverance.

While the proprietors of *good* quarries are amply compensated for their investment, there are those who have expended thousands of dollars in opening quarries that were completely worthless; and it may not be amiss to give some of the practical hints, that are presented in nature, to guide men in opening quarries.

In selecting a marble quarry care should be taken to secure one where there is a sufficient quantity of *sound* marble, so situated as to be accessible and easily drained if possible.

In order to form an opinion of the *soundness* of the marble, the adjacent rocks should be examined, and if they give evidence that there has been such disturbance among them as to cause a shattered structure, the chances are against a good workable quarry; but where the marble strata are well walled in, with sound rock, there is quite sure to be a corresponding soundness of the marble.

Good marble, of the softer varieties, is rarely found within twenty-five feet of the surface, hence the *dip* of the strata should be so great as to carry the beds *into* the ground beyond the influence of atmospheric agencies, unless the opening be made in the side of a hill, where the strata may be horizontal, as they will be protected by the over-lying rock and soil that form the elevation.

Several attempts have been made in Vermont to open quarries where there was a slight dip—not enough to take the bed deep into the earth—but in every case the effort has been attended with failure. A stratum of fine white marble may be found at the surface of the ground, lying horizontal, but it will be unsound in consequence of its exposure, and if it is removed by blasting, or otherwise, the stratum next below it may be marble of an inferior quality, or it *may* be a silicious limestone, or something else. Unless the edges of the strata can be seen, there is no certainty

in quarrying, and he who expends much money in blasting out rock that lies in horizontal beds, on level land, expecting to find marble that was never seen, must be a man with "large hope," and too visionary to ever succeed in business. Fruitless attempts have also been made to obtain sound marble near trap dikes.

Dikes are veins, or intruded masses of matter, in the rents or fissures of rocks, and differing essentially in composition from the rocks adjacent.

They are called "black streaks," or "ore veins," by marble workers, in consequence of their black and semi-metallic appearance.

They are often met with in Western Vermont, and vary in size from one-fourth of an inch to twenty feet in thickness, and often may be traced to the distance of a mile in length. They always prove injurious, and oftentimes ruinous, to marble quarries that they have penetrated. The marble is much more shattered and jointed near them than elsewhere, and there is this peculiarity about the joints:—they are usually parallel to the side of the dike. It is very difficult, if not impossible, to obtain a sound block of marble near a dike, and yet, strange as it may appear, many of the quarries opened forty years ago were by the side of one. Even within ten years, attempts have been made to blast out, and remove, the unsound rock, hoping to get deep enough into the earth to find it sound; but when it is known that the marble is jointed when near the dike, and that the origin of the dike is deep-seated, like the lava of an extinct volcano, how futile must be the attempt to get below its influence! As well might man attempt to remove the basaltic lava of Vesuvius! Before concluding these remarks, I will present a few facts in relation to the *position* of the marble, and its relation to the other rocks.

It is found that the strata on the South end of Dorset Mountain are nearly horizontal, and this is assumed to be their original position. The base of the mountain is composed of a silicious rock, known to geologists as a granular quartz rock or sandstone; and immediately above this, and reposing on it, is a silicious Limestone, the strata varying in color, structure and composition, generally containing more lime and less silica as it recedes from the quartz rock.

At the height of about 1263 feet above the village of East Dorset, the valuable quarry known as the "Vermont Italian Marble Quarry" is found, reposing on a silicious or magnesian limestone. This marble is not a pure carbonate of lime, but it contains so much silica as to render it hard to work; but the hardness, which may be objectionable to those who finish it, adds additional value to it, especially where it is to be placed in exposed situations.

The strata here, as I remarked, are nearly horizontal, and the quarry now worked has a thickness of about 47 feet of marble. [The speaker exhibited cubic specimens, 4 inches across, which had been furnished him by Messrs. Holley, Fields & Kent, of East Dorset, and to give the audience an idea of the beds, enumerated the name and thickness of each as follows, commencing at the bottom of the quarry, to wit :—

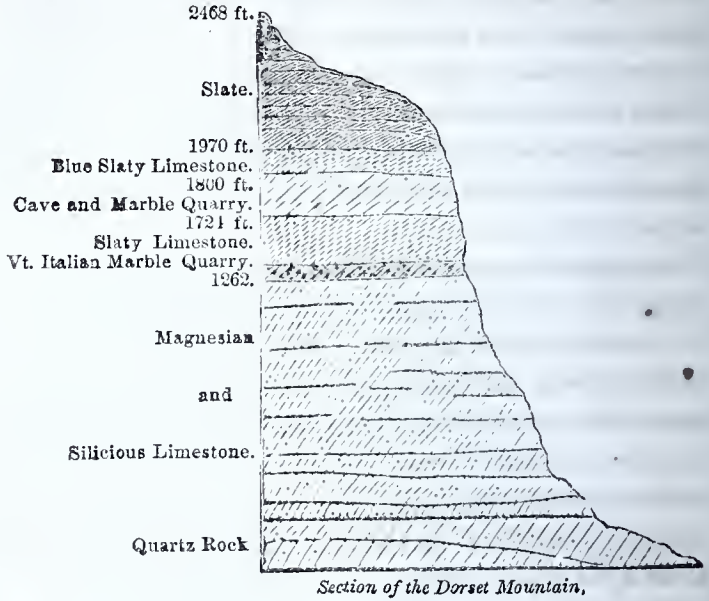
1st. Lower Birds Eye.... 16 inches.
2nd. Cast Iron Tier..... 14 "
3rd. Shale Tier..... 20 "
4th. Lower Dye..... 4 feet.
5th. Striped Tier..... 3½ "
6th. Cross Grained Tier.. 3 "
7th. Sheet Tier..... 15 inches.
8th. Thick White..... 20 "
9th. Upper Dye..... 22 inches.
10th. Fine White Tier.... 20 "
11th. Upper Shale..... 5 feet.
12th. Leopard Tier..... 5 "
13th. Upper Birds Eye... 4 "
14th. Striped Tier ... 2 "

The 15th, 16th, 17th and 18th tiers have, in all a thickness of 9 feet, and afford only a second quality of marble, generally striped.]

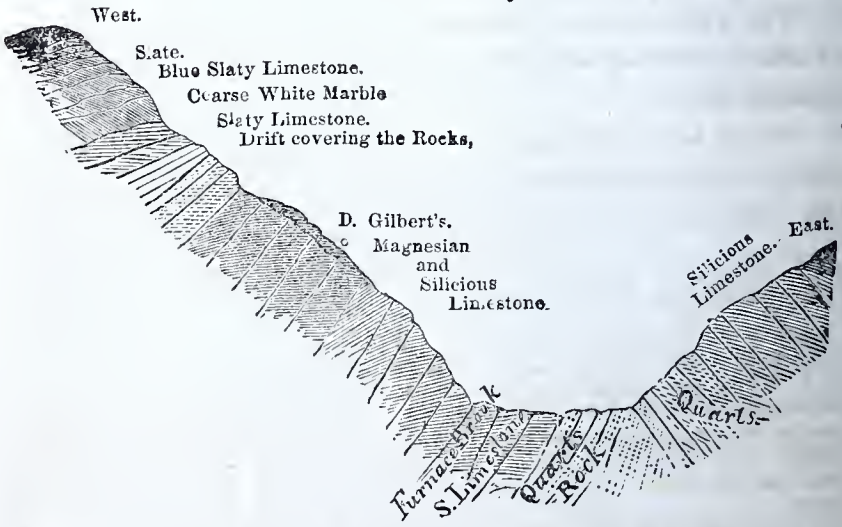
Immediately over this quarry there is a slaty formation of limestone, about 400 feet thick, upon which rests a coarse friable white marble, which forty years ago was quarried quite extensively at this place, and called the cave quarry, it being near a cave which is found on that mountain at an elevation of 1750 feet. This white marble formation has a thickness of about 100 feet, on top of which rests a blue limestone of about the same thickness. Upon this blue limestone, at an elevation of 1970 feet, a slate occurs, with concretionary masses of quartz in it, and extends to the top of the mountain which is 2468 feet high. [See "Section of Dorset Mountain," on next page.]

There are many places in Vermont where this order of occurrence is observed, but in no place is it more apparent than in Tinmouth, about one half mile South of the center of the town, where precisely the same order of rocks occur as at Dorset mountain, but instead of being in a horizontal position, those on the West side of Furnace Brook valley dip to the West at an angle of about 40

degrees, while those on the East side dip to the East at about the same angle, as represented by the diagram:



Section of the Dorset Mountain,



Section across Furnace Brook Vally, half a mile South of Tinmouth centre, and ten miles North of Dorset Mountain.

The line of fracture that exists between the rocks dipping East and West, can be traced about ten miles, through Tinmouth and Clarendon, being nearly on a line with Tinmouth or Chipman's Pond and the centre of the valley. The members of the series, commencing at the bottom are, quartz or sandstone, then silicious and

magnesian limestones,—then the white marbles, upon which occur the blue limestones, after which are found the slate forming the high ridges of the mountains on the West of the valley.

I will remark, that the beds corresponding to, and identical with, those of the Italian Marble Quarry, were not seen, but the rocks immediately above, and all those below, *did* occur, and in the same order that they were found upon Dorset Mountain; hence it appears but reasonable to suppose that the Italian beds *do* occur in Tinmouth, and in the South part of Clarendon, but are now hidden from view, by the accumulation of over-lying drift and soil. (*)

Did time permit, I would attempt to show the connection that exists between the Dorset, Danby and Rutland marbles, and describe minutely the several quarries found at these places, and the qualities of their different varieties of marble, as well as those found in Brandon and elsewhere; but I am admonished that I have already trespassed long upon your patience, and hence, will not enter upon those topics. (†)

The reputation of the Brandon, Rutland, Danby and Dorset marbles, is fixed, and it would be idle to add a word in their praise. (††)

As the son of Vermont goes abroad, well may he be proud that he is a Vermonter. He learns that his little State enjoys the enviable reputation of producing the best Horses and Sheep in the country, the most intelligent and persevering men and women in the world; and also, that the greatest variety, and the best marble in the market, is from old Vermont.

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* Since the above was written, G. M. Noble, M. D., the worthy representative from Tinmouth, having had his attention called to these facts, made an examination, during the recess of the Legislature, and actually found the bed of Italian Marble alluded to, and obtained a specimen of the marble, which was exhibited to the audience at the time this paper was read.

† I have been requested by several gentlemen to show, in this paper, the relation that exists between the Rutland, Danby and Dorset marbles, and also to give in detail a full history of the excellent varieties found in those places.

As it would necessarily require several diagrams to illustrate the various points, and a long explanation to accompany the same, I decline doing so, but send the paper as originally written, reserving the other facts, to be digested and embodied in the Final Report of the Geology of the State, by Prof. Hitchcock, our able and worthy State Geologist. A. D. H.

†† Specimens were exhibited from the quarries of Messrs. Sheldons & Slason, of West Rutland. J. Adair & Brother, of South Wallingford. E. D. Selden, Esq., of Brandon, Sutherland Falls Marble Co., of Sutherland's Falls, and Messrs. O. & A. D. Canfield, of Arlington.

We have many valuable beds in the State, that never have been worked,—principally varieties of the ornamental marble.

While we should strive by our acts to have the white and spotless marble, which is sent abroad, truly emblematic of the purity of our character and institutions, should we not also lend a helping hand to develope and bring forth the latent resources of the State, and use all lawful means to aid those who generously make the effort?

Should we not, for ornamental marbles, use our own, and by *example* try to exclude all others?

Were it not for raising a politieal question, I would enquire why there should not be greater duties charged upon imported blocks of marble—so as to enable our dealers to send their stock as far as New Orleans, and sell it as cheap as that from Italy?

Is it *necessary* to send abroad for the Egyptian marble, when we have such an abundance of beautiful black marble in our own State? Why send to the Pope's dominions for marble, when we have an article at Sutherland's Falls and Dorset, in many respects superior to the Italian? Why bring in the Sienna, when it can be obtained at Sudbury and elsewhere? Why the Brocatella, when the Winooski and other marbles are in every respect superior to it? And why the fine Florence or Carara marble, when the same thing can be obtained, in perfection, at Brandon and Rutland, and from the unopened quarries of Shelburne?

Let us encourage home industry, and use the products of our own State.

In the erection of public edifices and private dwellings, we should take occasion to use home products. Were the Architect and Superintendent, in finishing the Senate Chamber and Representatives Hall of our new State House, to use some of the new and untried varieties of Vermont marble, in the construction of the desks, tables, pillars and pilasters, I think it would be far more appropriate than to send abroad to obtain Mahogany from fillibustering Nicaragua or Yucatan. New varieties of marble would thus be brought before the world, and persons from abroad, where such choice varieties are not to be found, would forward orders for them, and thus in many cases the ledges which now disfigure our fields, would become sources of wealth to the proprietors, to the State, and to the nation.